

TFT-Display Datenblatt

Modell SCF0403852GGU03

Kurzdaten

| | |
|-------------|-----------------------------|
| Hersteller | Data Image |
| Diagonale | 4,3" / 10,9 cm |
| Format | 16:9 |
| Auflösung | 480 x 272 |
| Backlight | LED / 340 cd/m ² |
| Interface | RGB |
| Touchscreen | ja |
| Temperatur | -20... +70°C (Betrieb) |



Confidential Document

DATA IMAGE CORPORATION
CTP Module Specification
PRELIMINARY
ITEM NO.: SCF0403852GGU03

Table of Contents

| | |
|---|----|
| 1. COVER & CONTENTS | 1 |
| 2. RECORD OF REVISION | 2 |
| 3. GENERAL SPECIFICATIONS..... | 3 |
| 4. LCD ELECTRICAL CHARACTERISTICS | 3 |
| 5. BACKLIGHT POWER CONDITIONS..... | 3 |
| 6. BLOCK DIAGRAM | 4 |
| 7. LCD PIN CONNECTIONS | 5 |
| 8. LCD AC CHARACTERISTICS | 6 |
| 9. CTP INTERFACE AND DATA FORMAT..... | 9 |
| 10. CTP COMMAND | 13 |
| 11. OPTICAL CHARACTERISTIC | 25 |
| 12. QUALITY ASSURANCE | 27 |
| 13. LCM PRODUCT LABEL DEFINE | 28 |
| 14. PRECAUTIONS IN USE LCM | 30 |
| 15. OUTLINE DRAWING | 31 |
| 16. PACKAGE INFORMATION | 32 |

| | | | | |
|--------------------|-----------|--------------|-------------|--------------|
| Customer Companies | R&D Dept. | Q.C. Dept. | Eng. Dept. | Prod. Dept. |
| | ALEX | JOE | GARY | KEN |
| Approved by | Version: | Issued Date: | Sheet Code: | Total Pages: |
| | 3 | 1/NOV/12' | | 32 |

2. RECORD OF REVISION

| Rev | Date | Item | Page | Comment |
|-----|------------|------|------|--|
| 1 | 15/NOV/11' | | | Initial preliminary |
| 2 | 21/DEC/11' | 10 | 11 | Luminance of white- min.210 to 270 cd/m2, Typ.270 to 340 cd/m2 |
| 3 | 1/NOV/12' | 9 | 10 | Add the CTP Origin point |
| | | | 11 | Add Initialize the CTP controller |
| | | | 12 | Add data format |
| | | | 13 | Insert CTP COMMAND to Item 10,the next Item shift 1 number |
| | | | | |

3. GENERAL SPECIFICATIONS

Composition: 4.3 inch WQVGA resolution display with a projected Capacitive Touch Panel (CTP).

Interface : 24 bit parallel RGB for panel and I²C for the CTP.

| Parameter | Specifications | Unit |
|---|-------------------------------|-------|
| Display resolution | 480 X 272 | pixel |
| Screen size | 4.3(Diagonal) | inch |
| Outline dimension | 115.1 (W) x 73.9(H) x 4.95(D) | mm |
| Display active area | 95.04(W) x 53.856(H) | mm |
| Sensor active area | 95.812(W) x 58.366(H) | mm |
| Dot pitch | 0.066 (W) x 0.198(H) | mm |
| Color configuration | R.G.B. Stripe | |
| Back-light | LED | |
| Weight | TBD | g |
| View angle direction | 6 o'clock | |
| Our components and processes are compliant to RoHS standard | | |

4. LCD ELECTRICAL CHARACTERISTICS

GND=0V, Ta=25°C

| Parameter | Symbol | MIN. | Typ. | MAX. | Unit | Remark |
|---------------------------------|--------------------|--------|------|--------|-------|-----------------------|
| Power supply voltage | V _{DD} | 3.0 | 3.3 | 3.6 | V | Note1 |
| Power supply current | I _{DD} | | 21 | 30 | mA | V _{DD} =3.3V |
| Ripple voltage | V _{RPVDD} | | | 100 | mVp-p | |
| "H" level logical input voltage | V _{IH} | 0.7VDD | -- | VDD | V | |
| "L" level logical input voltage | V _{IL} | 0 | -- | 0.3VDD | V | |
| Operating temperature | Topa | -20 | -- | 70 | °C | Ambient temperature |
| Storage temperature | Tstg | -30 | -- | 80 | °C | Ambient temperature |

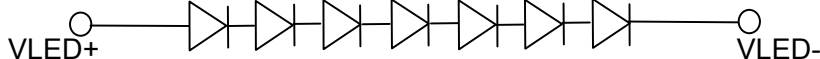
Note1: VDD Absolute Maximum Ratings -0.3V~+5V

5. BACKLIGHT POWER CONDITIONS

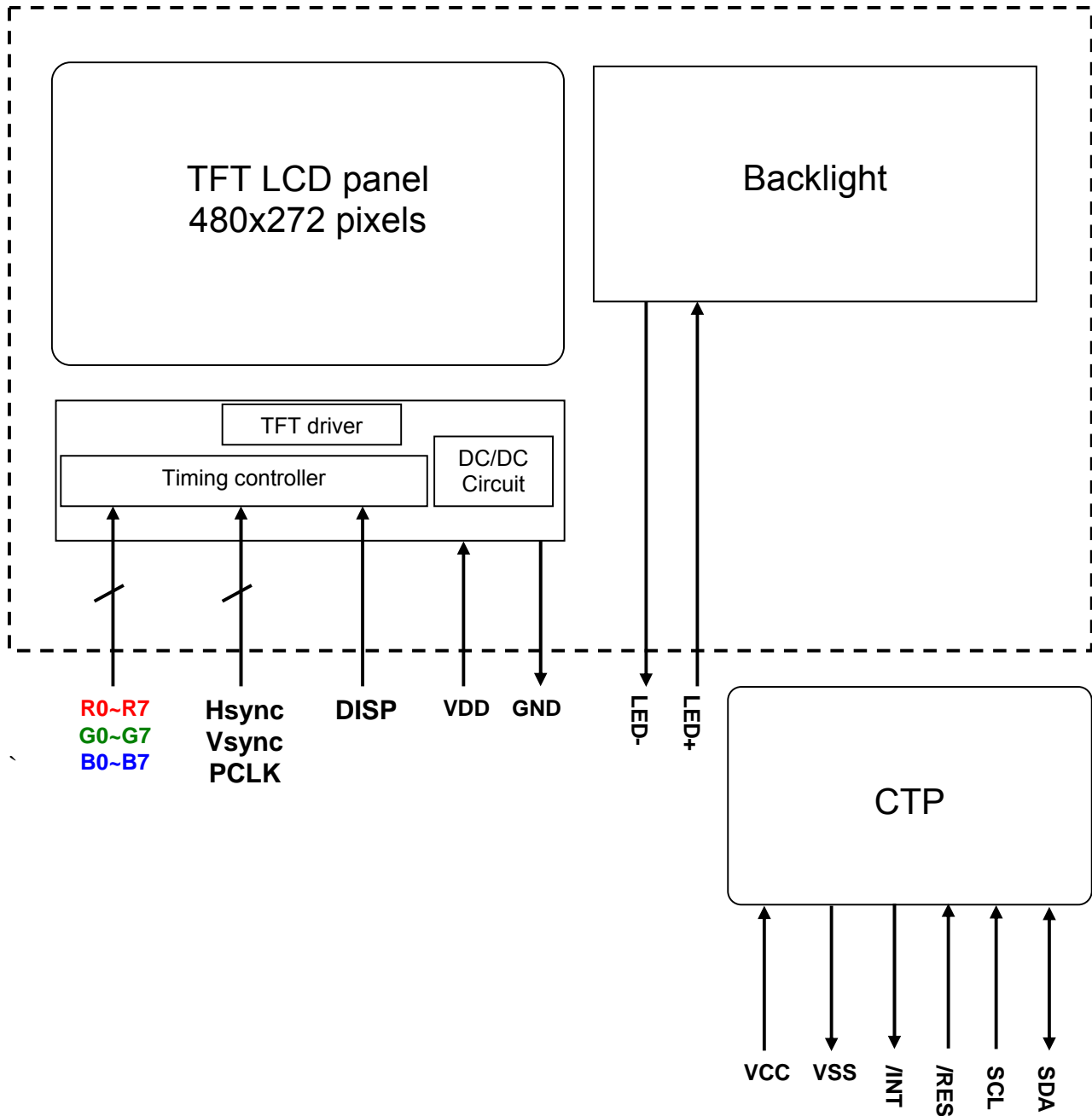
Ta= 25 °C

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Remark |
|---------------|------------------|--------|--------|------|-------|------------------------|
| LED current | I _{LED} | -- | 20 | -- | mA | |
| VLED voltage | V _{LED} | 21 | 23.1 | 26.6 | V | I _{LED} =20mA |
| LED life time | | 20,000 | 30,000 | | Hours | Note 1 |

Note 1 under room temperature (25 °C, Humidity 30-60% RH) and IL=20mA.



6. BLOCK DIAGRAM



7. LCD PIN CONNECTIONS

| Pin No | Symbol | Function | Remark |
|--------|----------|--|--------|
| 1 | VLED- | LED Power Supply Cathode. | |
| 2 | VLED+ | LED Power Supply Anode. | |
| 3 | NC | No Connection | |
| 4 | VDD | Power Supply : +3.3V | |
| 5 | R0 | Digital data input. R0 is LSB and R7 is MSB | |
| 6 | R1 | | |
| 7 | R2 | | |
| 8 | R3 | | |
| 9 | R4 | | |
| 10 | R5 | | |
| 11 | R6 | | |
| 12 | R7 | | |
| 13 | G0 | Digital data input. G0 is LSB and G7 is MSB | |
| 14 | G1 | | |
| 15 | G2 | | |
| 16 | G3 | | |
| 17 | G4 | | |
| 18 | G5 | | |
| 19 | G6 | | |
| 20 | G7 | | |
| 21 | B0 | Digital data input. B0 is LSB and B7 is MSB | |
| 22 | B1 | | |
| 23 | B2 | | |
| 24 | B3 | | |
| 25 | B4 | | |
| 26 | B5 | | |
| 27 | B6 | | |
| 28 | B7 | | |
| 29 | GND | Ground | |
| 30 | PCLK(CK) | clock signal to sample each data | |
| 31 | DISP | Display ON/OFF Control ON=H(VDD), OFF=L(GND) | |
| 32 | HSYNC | Horizontal synchronous signal | |
| 33 | VSNC | Vertical synchronous signal | |
| 34 | NC | No Connection | |
| 35 | NC | No Connection | |
| 36 | GND | Ground | |
| 37 | NC | No Connection | |
| 38 | NC | No Connection | |
| 39 | NC | No Connection | |
| 40 | NC | No Connection | |

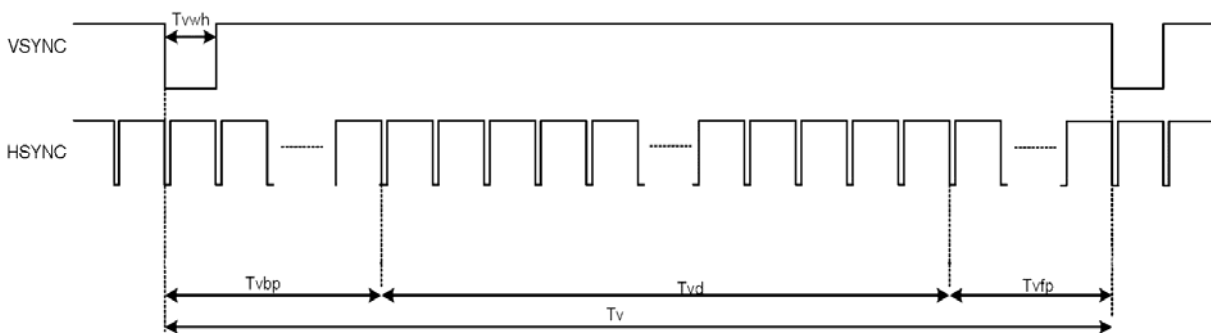
8. LCD AC CHARACTERISTICS

8.1 Input Timing Requirement

 (480RGBx272, $T_a = 25^\circ\text{C}$, $V_{DD} = 3.3\text{V}$ $GND = 0\text{V}$)

| Parameter | Symbol | Min. | Typ. Value | Max. | Unit |
|--------------------|-----------|------|------------|------|------|
| CK frequency | fclk | 5 | 9 | 12 | MHz |
| VSYNC period time | T_v | 282 | 288 | 373 | H |
| VSYNC display area | T_{vd} | 272 | | | H |
| VSYNC back porch | T_{vbp} | 8 | 8 | 8 | H |
| VSYNC front porch | T_{vfp} | 2 | 8 | 93 | H |
| HSYNC period time | T_h | 524 | 525 | 585 | CK |
| HSYNC display area | T_{hd} | 480 | | | CK |
| HSYNC back porch | T_{hbp} | 40 | 40 | 40 | CK |
| HSYNC front porch | T_{hfp} | 4 | 5 | 65 | CK |

Vertical input timing



Horizontal input timing

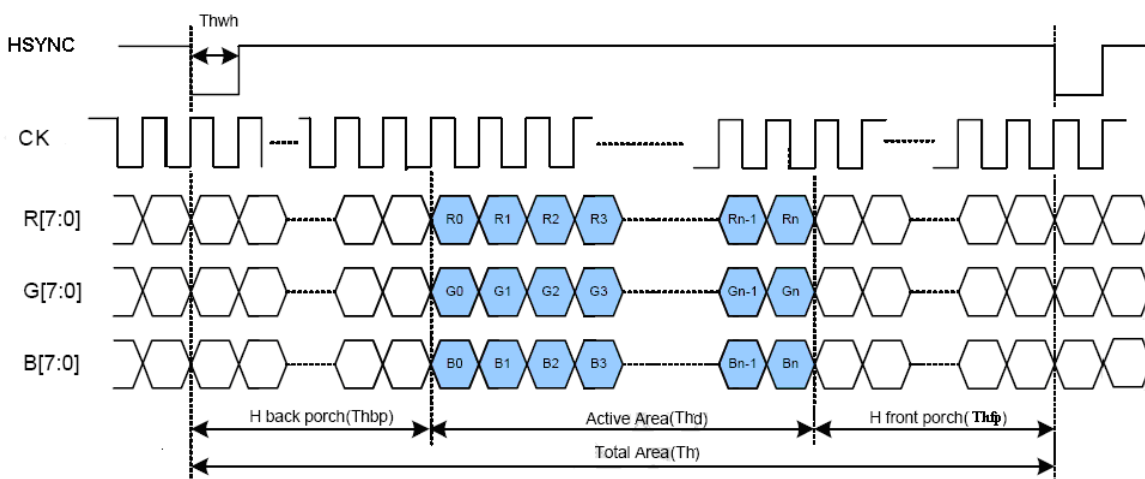
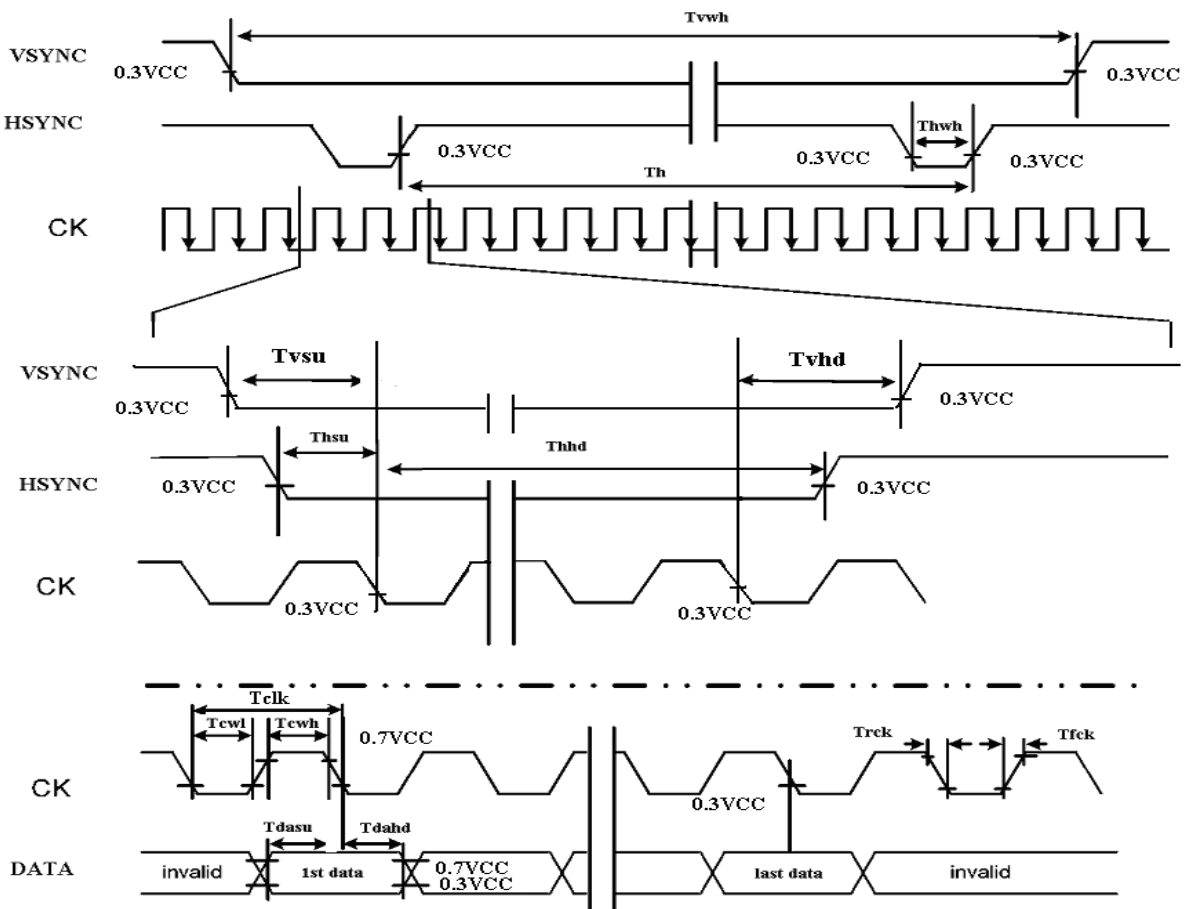


Fig 1. Parallel RGB input timing

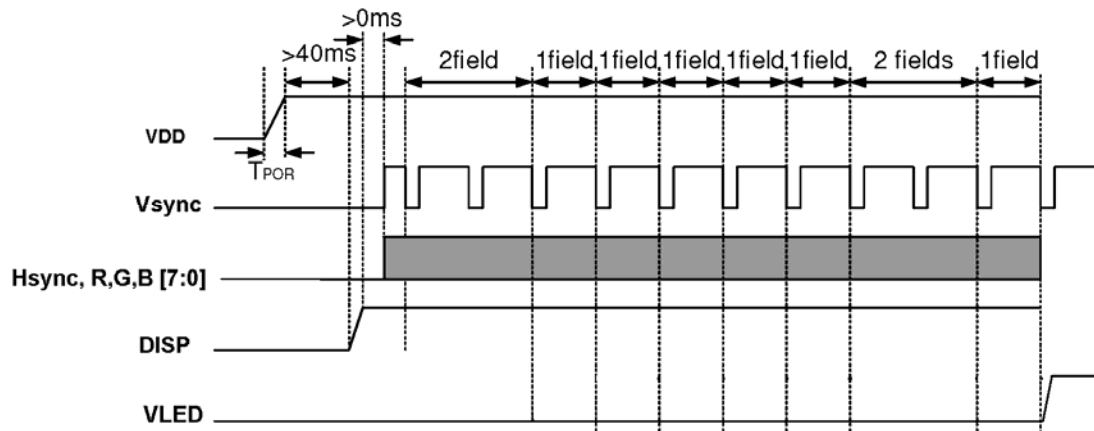
8.2 Input Setup Timing Requirement
 (VDD = 3.0 to 3.6V, GND=0V, TA=-20 to +85°C)

| Parameters | Symbol | Min. | Typ. | Max. | Unit | Conditions |
|----------------------|--------|------|------|------|------|------------|
| CK clock time | Tclk | 33.3 | - | - | ns | CK =30MHz |
| CK clock low period | Tcwl | 40 | - | 60 | % | |
| CK clock high period | Tcwh | 40 | - | 60 | % | |
| Clock rising time | Trck | 9 | - | - | ns | |
| Clock falling time | Tfck | 9 | - | - | ns | |
| HSYNC width | Thwh | 1 | - | - | CK | |
| HSYNC period time | Th | 55 | 60 | 65 | us | |
| HSYNC setup time | Thsu | 12 | - | - | ns | |
| HSYNC hold time | Thhd | 12 | - | - | ns | |
| VSYNC width | Tvwh | 1 | - | - | Th | |
| VSYNC setup time | Tvsu | 12 | - | - | ns | |
| VSYNC hold time | Tvhd | 12 | - | - | ns | |
| Data setup time | Tdasu | 12 | - | - | ns | |
| Data hold time | Tdahd | 12 | - | - | ns | |

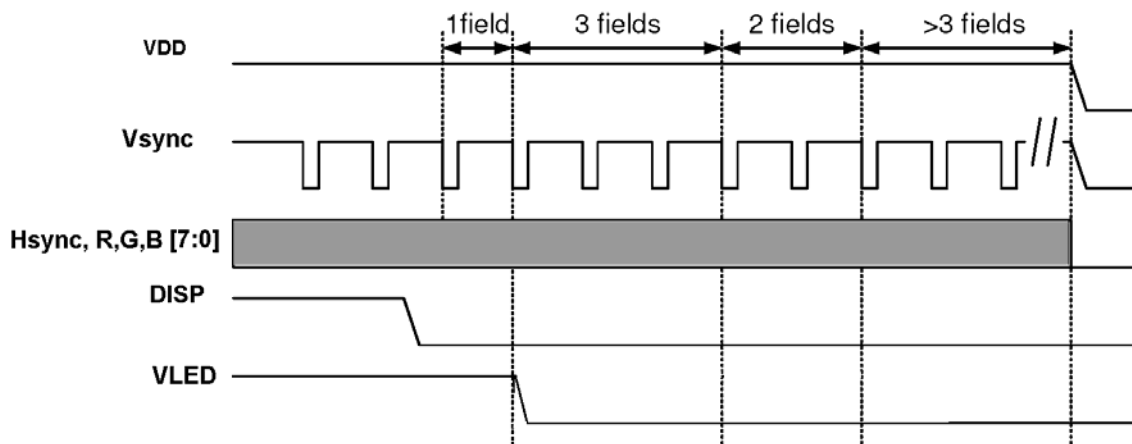

Fig 2. Input setup timing requirement

8.3 Power on/off sequence:

- Power on sequence



- Power off sequence



9. CTP INTERFACE AND DATA FORMAT

9.1 CTP Absolute Maximum Rating

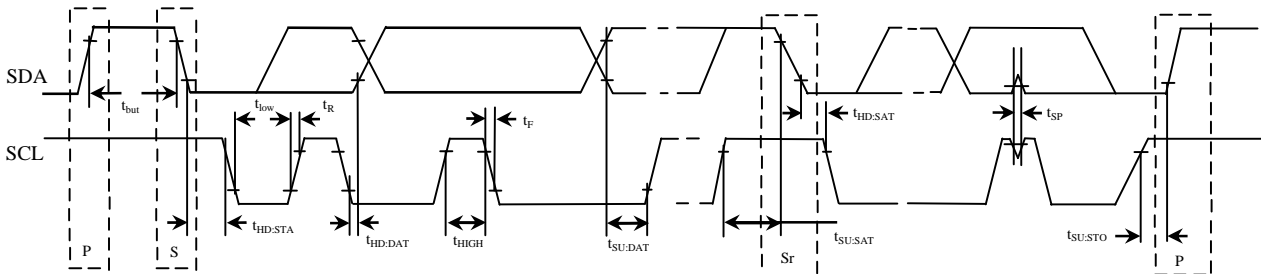
| Parameter | Symbol | Spec. | | | Unit |
|---------------------------------------|----------------|-------|----|---------|------|
| Supply voltage | VCC | -0.3 | - | 7 | V |
| Switch control signals output current | Output current | - | 50 | - | mA |
| Enable control voltage range | Logic Input | -0.3 | - | VCC+0.3 | V |
| Output Control Driver | Output voltage | -0.3 | - | VCC | V |

9.2 CTP Electrical Characteristic

| Symbol | Description | Min | Typ | Max | Unit | Notes |
|--------|----------------|-----|-----|-----|------|-------|
| VCC | Supply voltage | 2.5 | 3.3 | 3.5 | V | |

9.3 Interface and Data Format (Slave address is 0x94H)

9.3.1 AC characteristics of the SDA and SCL bus lines for I²C-bus devices



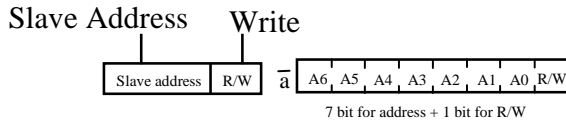
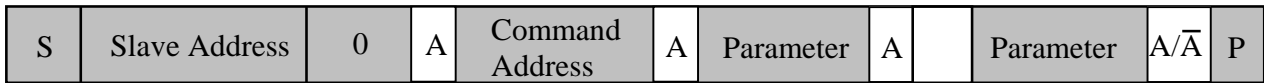
| Parameter | Symbol | Standard-Mode I ² C-BUS | | Fast-Mode I ² C-BUS | | Unit |
|---|--------------|------------------------------------|------|--------------------------------|------|---------|
| | | Min. | Max. | Min. | Max. | |
| SCL clock frequency | f_{SCL} | 0 | 100 | 0 | 400 | KHz |
| Bus free time between STOP and START condition | t_{BUF} | 4.7 | - | 1.3 | - | μ s |
| Hold time (repeated) START condition. After this period, the first clock pulse is generated | $t_{HD:STA}$ | 4.0 | - | 0.6 | - | μ s |
| LOW period of the SCL clock | t_{LOW} | 4.7 | - | 1.3 | - | μ s |
| HIGH period of the SCL clock | t_{HIGH} | 4.0 | - | 0.6 | - | μ s |
| Set-up time for a repeated START condition | $t_{SU:STA}$ | 4.7 | - | 0.6 | - | μ s |
| Data hold time | $t_{HD:DAT}$ | 0 | - | 0 | 0.9 | μ s |
| Data set-up time | $t_{SU:DAT}$ | 250 | - | 100 | - | μ s |
| Rise time of both SDA and SCL signals | t_R | - | 1000 | $20+0.1C_b$ | 300 | μ s |
| Fall time of both SDA and SCL signals | t_F | - | 300 | $20+0.1C_b$ | 300 | μ s |
| Set-up time for STOP condition | $t_{SU:STO}$ | 4.0 | - | 0.6 | - | μ s |
| Capacitive load for each bus line. | C_b | - | 400 | - | 400 | pF |

Note:

- (1) All values are referred to VIH (0.7xVCC) and VIL (0.3xVCC) level.
- (2) A device must internally provide a hold time of at least 300ns for the SDA signal (referred to the VIH of the SCL signal) in order to bridge the undefined region of the falling edge of SCL.
- (3) The maximum $t_{HD:DAT}$ has only to be met if the device does not stretch the LOW period (t_{LOW}) of the SCL signal.
- (4) A fast-mode I²C-bus device can be used in a standard-mode I²C-bus system, but the requirement $t_{SU:DAT} \geq 250$ ns must then be met. This will automatically be the case if the device does not stretch the LOW period of the SCL signal. If such a device does stretch the LOW period of the SCL signal, it must output the next data bit to the SDA line $t_{R,max} t_{SU:DAT} = 1000+250=1250$ ns (according to the standard-mode I²C-bus specification) before the SCL line is released.
- (5) C_b = total capacitance of one bus line in pF.

9.3.2 Format of Data Frame

Write mode



From master to slave

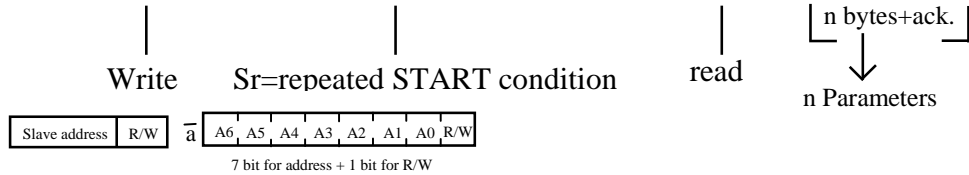
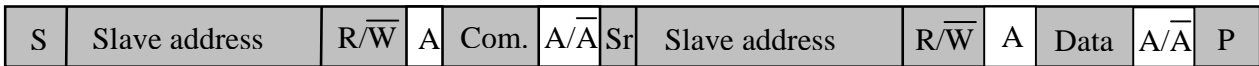


From slave to master

\bar{A} = acknowledge (SDA LOW)
 A = not acknowledge (SDA HIGH)
 S = START condition
 P = STOP condition

Data Format of writing mode

Read mode



From master to slave



From slave to master

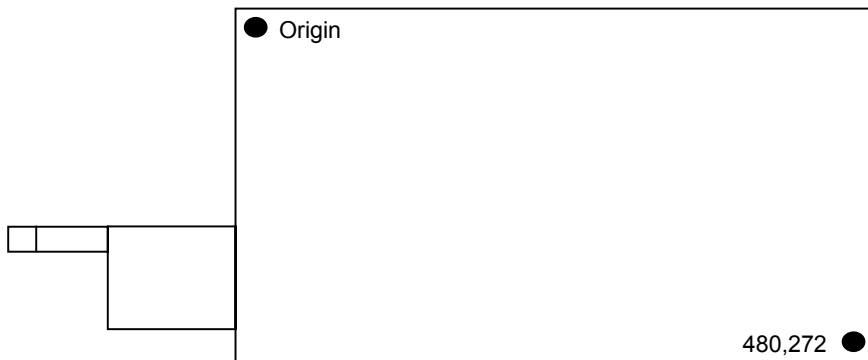
\bar{A} = acknowledge (SDA LOW)
 A = not acknowledge (SDA HIGH)
 S = START condition
 P = STOP condition

Data Format of reading mode

9.4 CTP Pin Connections

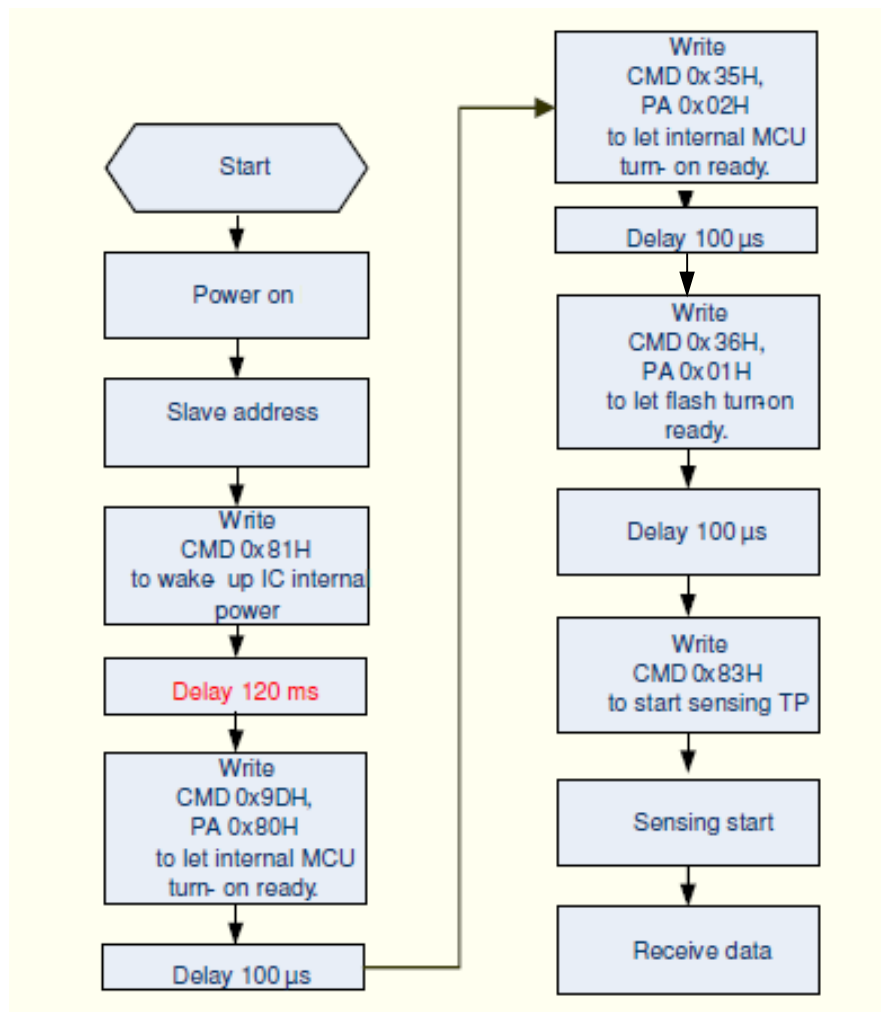
| No. | Name | I/O | Description |
|-----|------|-----|--|
| 1 | VCC | - | Power; VCC=3.3V |
| 2 | RES | I | NC pin; please keep floating |
| 3 | INT | O | Active low when data output from touch panel |
| 4 | SDA | I/O | Serial data |
| 5 | SCL | I | Serial clock |
| 6 | VSS | - | Ground |

9.5 CTP Origin point



9.6 Initialize the CTP controller

| |
|---|
| When want to initial controller, external MCU must execute wake-up command to let IC starting to work |
| Command 0x81H is used to wake-up IC internal power. |
| Command 0x9DH, parameter 0x80H to set high speed mode. |
| Command 0x35H, parameter 0x02H is used to let internal MCU turn-on ready. |
| Command 0x36H, parameter 0x01H is used to let flash turn-on ready. |
| Command 0x83H is used to start sensing touch panel. |
| Command 0x88H is used to clear stack. |

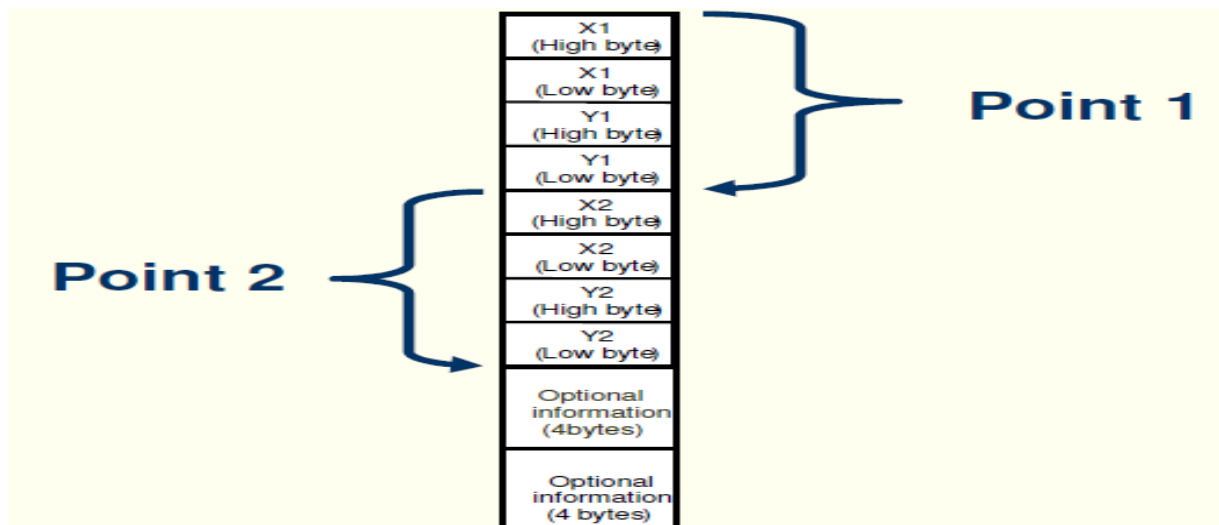


9.7 Data format

When finger touch, enter event will occurred and coordinate data will be calculated, and than interrupt signal appear (TSIX pull low).

Baseband should receive data when interrupt occur.

Every point will contains 4 bytes, 2 bytes for X and 2 bytes for Y, if support point is 2, total point data : $2 \times 4 = 8$ bytes, and 8 bytes will be added for optional information (point count, ID information, hot key, etc.), so totally data length is (support points \times 4) + (8 bytes optional information)



- When one or more points (but not all) have been touched, other points without touched will be fill **invalid data 0xFFFF** to let baseband distinguish which point has been touched or not.

Example 1: Support 2 points, one point has been touched.

X1 = 150 (0x0096H), Y1 = 230 (0x00E6H)

X2 = 65535 (0xFFFFH), Y2 = 65535 (0xFFFFH)

| | | | |
|----------------|-----------------------|------------------------|---------------------------------------|
| Point 1 | Date[0] = 0x00 | Date[8] = 0xFF | No use, invalid data |
| | Date[1] = 0x96 | Date[9] = 0xFF | |
| | Date[2] = 0x00 | Date[10] = 0xFF | |
| | Date[3] = 0xE6 | Date[11] = 0xFF | |
| Point 2 | Date[4] = 0xFF | Date[12] = 0xF1 | 1 point enter, point count = 0xF1 |
| | Date[5] = 0xFF | Date[13] = 0x01 | First point enter, Point ID = 0x01 |
| | Date[6] = 0xFF | Date[14] = 0xFF | No use, |
| | Date[7] = 0xFF | Date[15] = 0xFF | invalid data |

10. CTP COMMAND

10.1 Command list

| Hex | Operation Code | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Function |
|-------------------|-------------------|-----|-----|-----|-----|-----|-----|-----|-----|----------|
| 0 | No operation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| 80 | Sleep IN | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| 81 | Sleep Out | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | - |
| 82 | Sense Off | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | - |
| 83 | Sense On | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | - |
| 85 | Read Event | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | - |
| | 1st parameter | B31 | B30 | B29 | B28 | B27 | B26 | B25 | B24 | - |
| | 2nd parameter | B23 | B22 | B21 | B20 | B19 | B18 | B17 | B16 | - |
| | 3rd parameter | B15 | B14 | B13 | B12 | B11 | B10 | B9 | B8 | - |
| | 4th parameter | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | - |
| 86 | Read All Events | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | - |
| | 1st parameter | B31 | B30 | B29 | B28 | B27 | B26 | B25 | B24 | - |
| | 2nd parameter | B23 | B22 | B21 | B20 | B19 | B18 | B17 | B16 | - |
| | 3rd parameter | B15 | B14 | B13 | B12 | B11 | B10 | B9 | B8 | - |
| | 4th parameter | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | - |
| | 5th parameter | E3 | E2 | E1 | E0 | F1 | P2 | P1 | P0 | - |
| | 6th parameter | B23 | B22 | B21 | B20 | B19 | B18 | B17 | B16 | - |
| | ... | : | : | : | : | : | : | : | : | - |
| (n+1)th parameter | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | - | |
| 87 | Read Latest Event | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | - |
| | 1st parameter | B31 | B30 | B29 | B28 | B27 | B26 | B25 | B24 | - |
| | 2nd parameter | B23 | B22 | B21 | B20 | B19 | B18 | B17 | B16 | - |
| | 3rd parameter | B15 | B14 | B13 | B12 | B11 | B10 | B9 | B8 | - |
| | 4th parameter | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | - |
| 88 | Clear Stack | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | - |

10.2 User define command list table

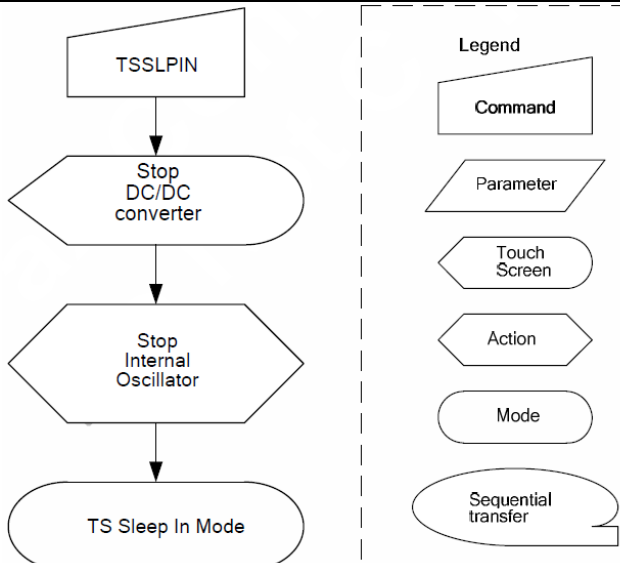
| Hex | Operation Code | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Function |
|-----|----------------|----|----|----|----|----|----|----|----|-------------------------|
| 31h | Device ID | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | Response Device ID Code |
| | 1st parameter | 85 | | | | | | | | - |
| | 2nd parameter | 20 | | | | | | | | - |
| | 3rd parameter | 00 | | | | | | | | - |
| 32h | Version ID | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | Read Firmware version |

10.3. Command description

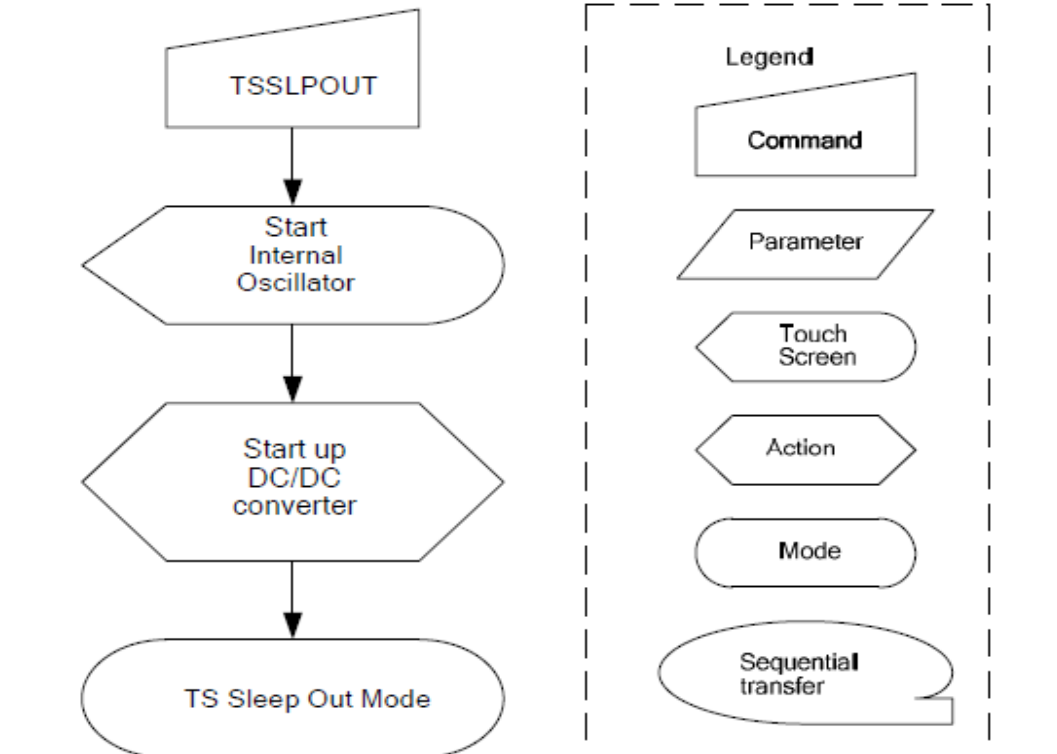
10.3.1 NOP

| 00 H | NOP (No Operation) | | | | | | | | | |
|-----------------------|---|----|----|----|----|---------------|----|----|----|-----|
| | DNC | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | HEX |
| Command | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 00 |
| Parameter | No parameter | | | | | | | | | |
| Description | This command is an empty command and it does not have any effect on the touch screen. | | | | | | | | | |
| Restriction | | | | | | | | | | |
| Register Availability | Status | | | | | Availability | | | | |
| | TS Sleep Out | | | | | Yes | | | | |
| | TS Sleep In | | | | | Yes | | | | |
| Default | Status | | | | | Default Value | | | | |
| | Power Up Sequence | | | | | N/A | | | | |
| | TS S/W Reset | | | | | N/A | | | | |
| | H/W Reset | | | | | N/A | | | | |
| Flow Chart | | | | | | | | | | |

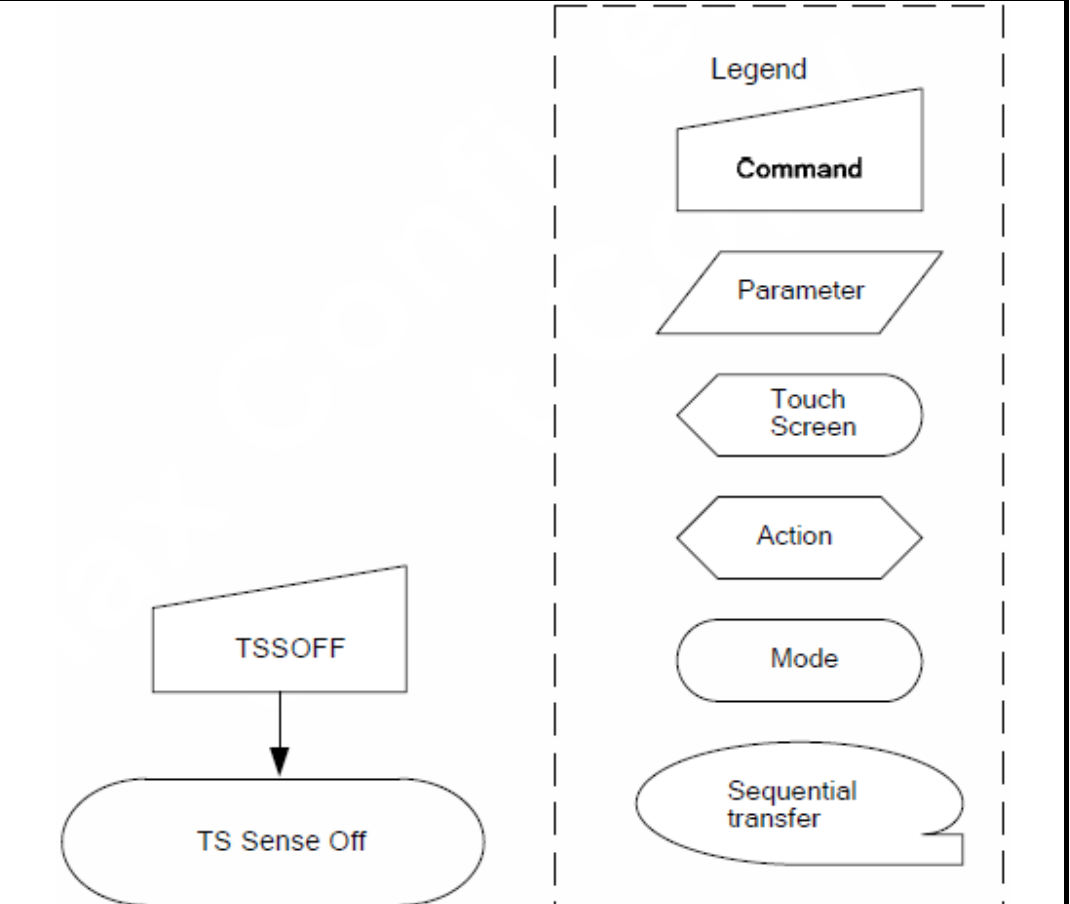
10.3.2 TS sleep in (80h)

| 80H | TSSLPIN (Touch Screen Sleep In) | | | | | | | | | |
|-----------------------|--|----|----|----|----|------------------|----|----|----|-----|
| | DNC | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | HEX |
| Command parameter | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 80 |
| Description | This command causes the touch screen to enter the minimum power consumption mode. MCU interface are register are still working and keeps their contents. | | | | | | | | | |
| Restriction | This command has no effect when the touch screen is already in TS Sleep In mode. TS Sleep In Mode can only be left by the TS Sleep Out Command (81h). It will be necessary to wait 5msec before sending next command. This is to allow time for the supply voltages and clock circuits to stabilize. It will be necessary to wait 5msec after sending TS Sleep Out command (when in TS Sleep In Mode) before TS Sleep In command can be sent. | | | | | | | | | |
| Register Availability | Status | | | | | Availability | | | | |
| | TS Sleep Out | | | | | Yes | | | | |
| | TS Sleep In | | | | | Yes | | | | |
| Default | Status | | | | | Default Value | | | | |
| | Power Up Sequence | | | | | TS Sleep In Mode | | | | |
| | TS S/W Reset | | | | | TS Sleep In Mode | | | | |
| | H/W Reset | | | | | TS Sleep In Mode | | | | |
| Flow Chart |  <pre> graph TD TSSLPIN[/TSSLPIN/] --> StopDCDC{{Stop DC/DC converter}} StopDCDC --> StopIO{{Stop Internal Oscillator}} StopIO --> TSSleepIn([TS Sleep In Mode]) </pre> <p>Legend</p> <ul style="list-style-type: none"> Command: Parallelogram Parameter: Hexagon Touch Screen: Oval Action: Hexagon Mode: Oval Sequential transfer: Oval with tail | | | | | | | | | |

10.3.3 TS sleep out (81h)

| 81H | TSSLPOUT (Touch Screen Sleep Out) | | | | | | | | | |
|-----------------------|---|----|----|----|----|------------------|----|----|----|-----|
| | DNC | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | HEX |
| Command | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 81 |
| parameter | No parameter | | | | | | | | | |
| Description | This command turns off TS Sleep In mode. | | | | | | | | | |
| Restriction | This command has no effect when touch screen is already in TS Sleep Out mode. TS Sleep Out Mode can only be left by the TS Sleep In Command (80h). It will be necessary to wait 5msec before sending next command. This is to allow time for the supply voltages and clock circuits to stabilize. The touch screen loads all touch screen supplier's factory default values to the registers during this 5msec and there cannot be any abnormal effect on the touch screen functionality if factory default and register values are same when this load is done and when the touch screen is already TS Sleep Out – mode. It will be necessary to wait 5msec after sending TS Sleep In command (when in TS Sleep Out mode) before TS Sleep Out command can be sent. | | | | | | | | | |
| Register Availability | Status | | | | | Availability | | | | |
| | TS Sleep Out | | | | | Yes | | | | |
| | TS Sleep In | | | | | Yes | | | | |
| Default | Status | | | | | Default Value | | | | |
| | Power Up Sequence | | | | | TS Sleep In Mode | | | | |
| | TS S/W Reset | | | | | TS Sleep In Mode | | | | |
| | H/W Reset | | | | | TS Sleep In Mode | | | | |
| Flow Chart |  <pre> graph TD A[TSSLPOUT] --> B(Start Internal Oscillator) B --> C{{Start up DC/DC converter}} C --> D([TS Sleep Out Mode]) </pre> | | | | | | | | | |

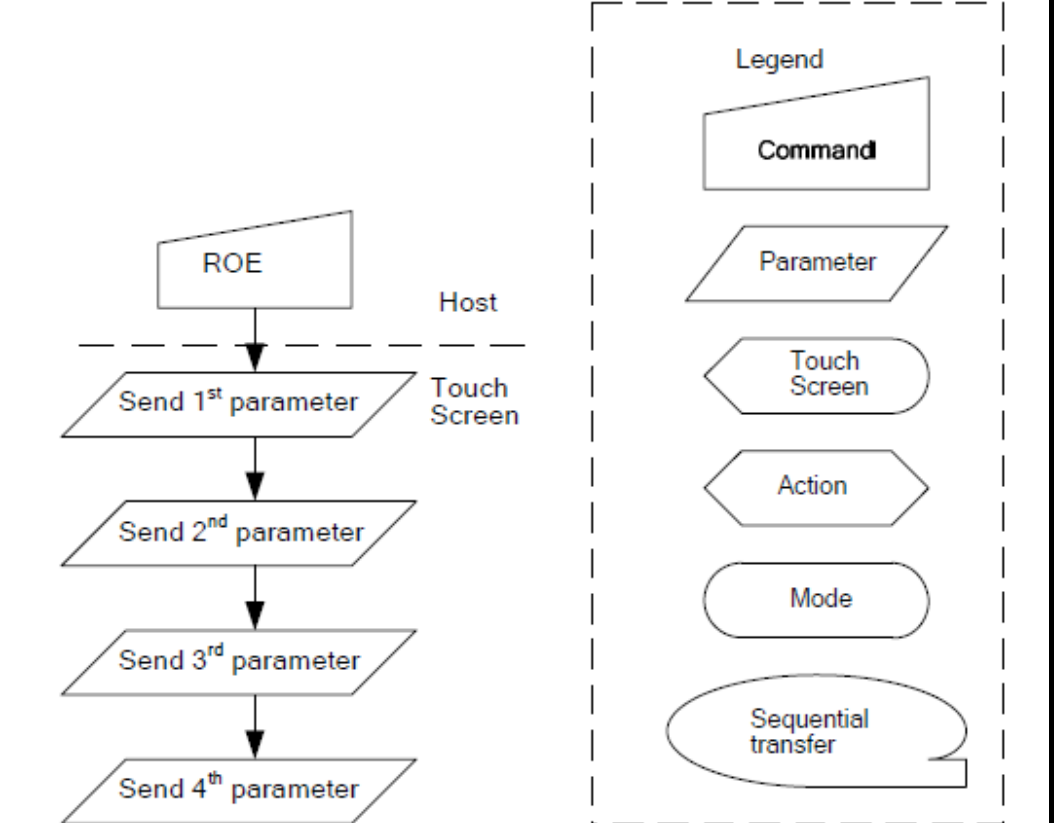
10.3.4 TS sense off (82h)

| 82H | TSSOFF (Touch Screen Sense Off) | | | | | | | | | |
|-----------------------|---|----|----|----|----|---------------|----|----|----|-----|
| | DNC | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | HEX |
| Command | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 82 |
| parameter | No parameter | | | | | | | | | |
| Description | The touch screen is not sensing touches (= No new events), but the touch screen is still scanning. | | | | | | | | | |
| Restriction | | | | | | | | | | |
| Register Availability | Status | | | | | Availability | | | | |
| | TS Sleep Out | | | | | Yes | | | | |
| | TS Sleep In | | | | | Yes | | | | |
| Default | Status | | | | | Default Value | | | | |
| | Power Up Sequence | | | | | TS Sense Off | | | | |
| | TS S/W Reset | | | | | TS Sense Off | | | | |
| | H/W Reset | | | | | TS Sense Off | | | | |
| Flow Chart |  <p>The flow chart illustrates the execution of the TSSOFF command. The command, represented by a trapezoid, leads to the 'TS Sense Off' mode, represented by a rounded rectangle. A legend on the right defines the symbols used: Command (trapezoid), Parameter (parallelogram), Touch Screen (hexagon), Action (hexagon), Mode (rounded rectangle), and Sequential transfer (oval with tail).</p> | | | | | | | | | |

10.3.5 TS sense on (83h)

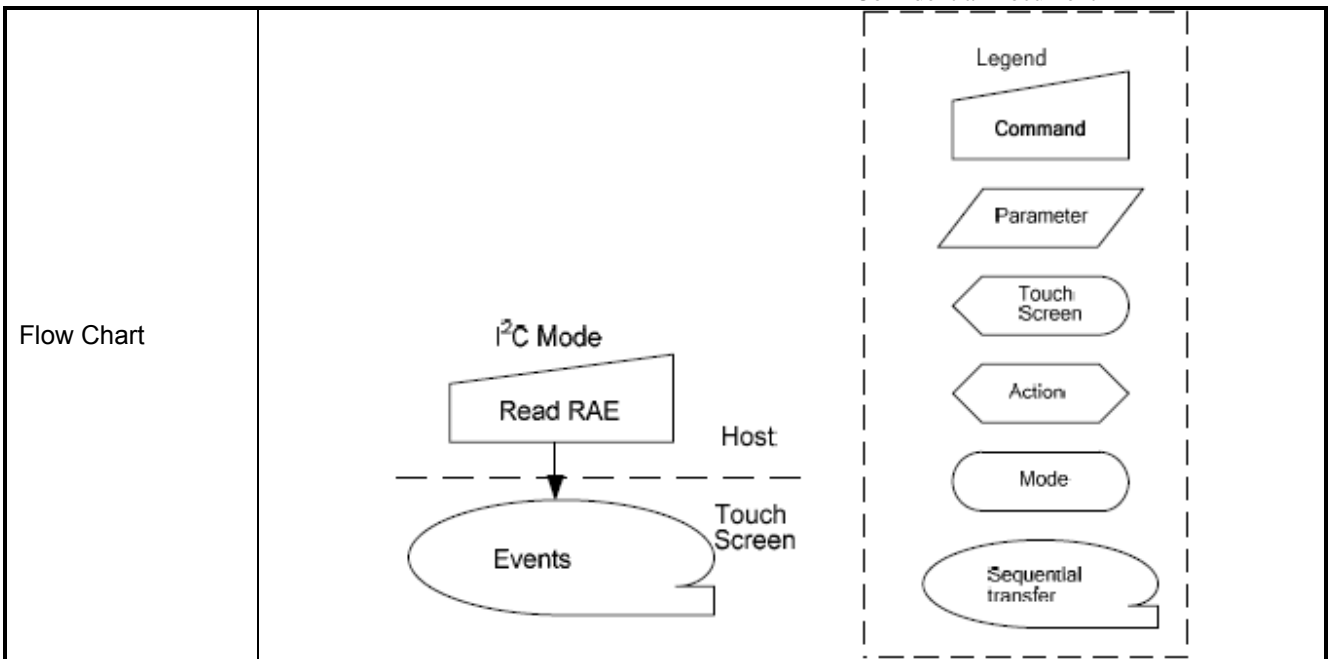
| 83H | TSSON (Touch Screen Sense On) | | | | | | | | | |
|-----------------------|--|----|----|----|----|---------------|----|----|----|-----|
| | DNC | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | HEX |
| Command | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 83 |
| parameter | No parameter | | | | | | | | | |
| Description | The touch screen is sensing touches (= No new events). | | | | | | | | | |
| Restriction | | | | | | | | | | |
| Register Availability | Status | | | | | Availability | | | | |
| | TS Sleep Out | | | | | Yes | | | | |
| | TS Sleep In | | | | | Yes | | | | |
| Default | Status | | | | | Default Value | | | | |
| | Power Up Sequence | | | | | TS Sense Off | | | | |
| | TS S/W Reset | | | | | TS Sense Off | | | | |
| | H/W Reset | | | | | TS Sense Off | | | | |
| Flow Chart | <div style="border: 1px dashed black; padding: 10px;"> <p style="text-align: center;">Legend</p> <div style="display: flex; flex-direction: column; align-items: center;"> <div style="border: 1px solid black; width: 100px; height: 30px; margin-bottom: 5px;"></div> <div style="border: 1px solid black; width: 100px; height: 30px; margin-bottom: 5px; transform: rotate(-2deg);"></div> <div style="border: 1px solid black; width: 100px; height: 30px; margin-bottom: 5px; border-radius: 15px;"></div> <div style="border: 1px solid black; width: 100px; height: 30px; margin-bottom: 5px; border-top: none; border-bottom: none;"></div> <div style="border: 1px solid black; width: 100px; height: 30px; margin-bottom: 5px; border-radius: 15px;"></div> <div style="border: 1px solid black; width: 100px; height: 30px; margin-bottom: 5px; border-radius: 15px;"></div> </div> <div style="margin-top: 20px; text-align: center;"> <div style="border: 1px solid black; width: 150px; height: 40px; margin: 0 auto 10px auto;"></div> <div style="margin: 0 auto 10px auto;">↓</div> <div style="border: 1px solid black; width: 250px; height: 50px; margin: 0 auto;"></div> </div> </div> | | | | | | | | | |

10.3.6 Read One Event (85h)

| 85H | | ROE (Read One Event) | | | | | | | | | |
|-----------------------|-----------|---|-----|-----|-----|-----|---------------|-----|-----|-----|-----|
| | | DNC | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | HEX |
| Command | | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 85 |
| 1 | parameter | - | B31 | B30 | B29 | B28 | B27 | B26 | B25 | B24 | xx |
| 2 | parameter | - | B23 | B22 | B21 | B20 | B19 | B18 | B17 | B16 | xx |
| 3 | parameter | - | B15 | B14 | B13 | B12 | B11 | B10 | B9 | B8 | xx |
| 4 | parameter | - | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | xx |
| Description | | This command returns touch co-ordinates what is the oldest co-ordinates information what has been stored on the stock. A returning value can be "No Event" if the stock is empty. The default assignment is list as below. The assignment of event stack also can be modified if necessary (base on the requirement of customer). | | | | | | | | | |
| Register Availability | | Status | | | | | Availability | | | | |
| | | TS Sleep Out | | | | | Yes | | | | |
| | | TS Sleep In | | | | | Yes | | | | |
| Default | | Status | | | | | Default Value | | | | |
| | | Power Up Sequence | | | | | 0000 0000h | | | | |
| | | TS S/W Reset | | | | | 0000 0000h | | | | |
| | | H/W Reset | | | | | 0000 0000h | | | | |
| Flow Chart | |  <p>The flowchart illustrates the communication sequence between the Host and the Touch Screen for the Read One Event (ROE) command. The Host initiates the process by sending the ROE command. The Touch Screen then responds by sending four parameters in a sequential order: the 1st parameter, the 2nd parameter, the 3rd parameter, and the 4th parameter. A legend on the right side of the flowchart defines the symbols used: a trapezoid for 'Command', a parallelogram for 'Parameter', a hexagon for 'Touch Screen', another hexagon for 'Action', a rounded rectangle for 'Mode', and an oval with a tail for 'Sequential transfer'.</p> | | | | | | | | | |

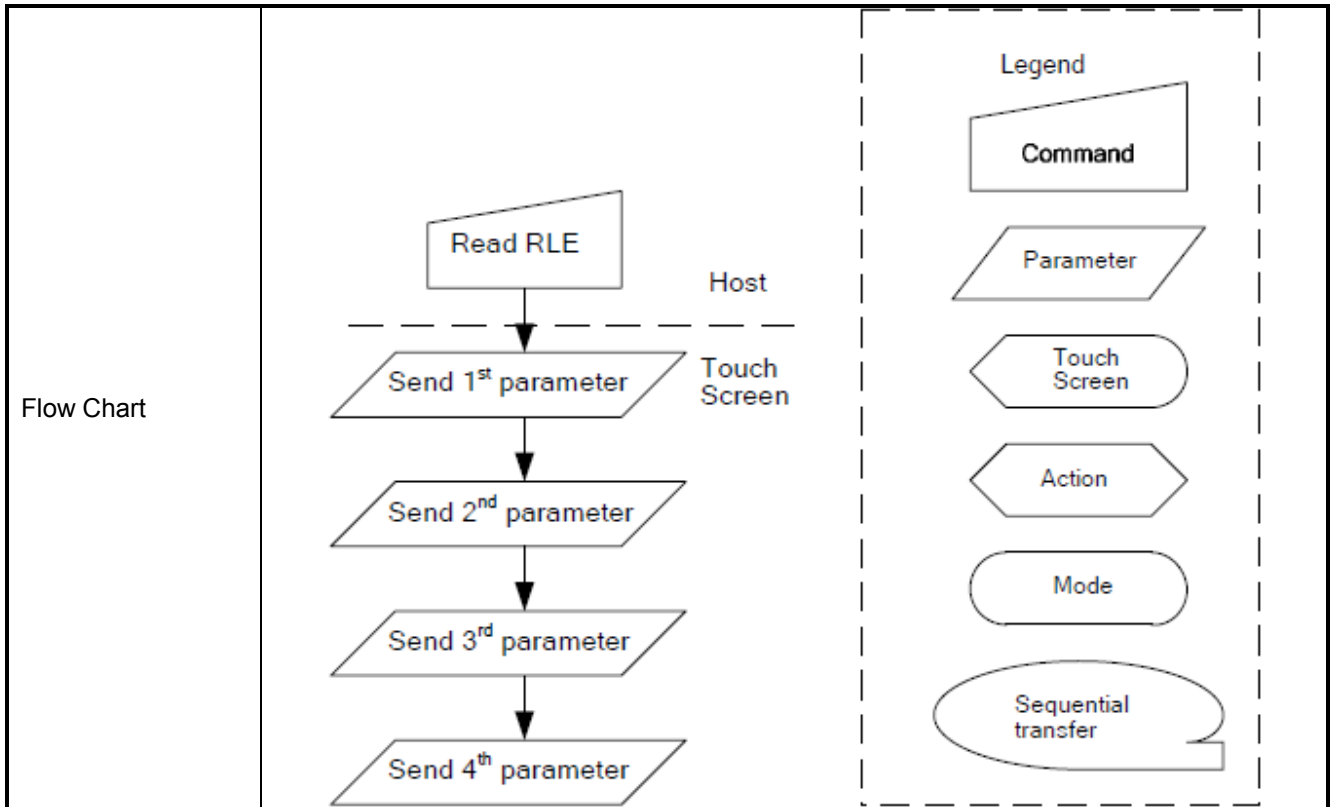
10.3.7 Read All Event (86h)

| 86H | | RAE (Read All Events) | | | | | | | | | |
|-----------------------|-----------|--|-----|-----|-----|-----|-----------------------|-----|-----|-----|-----|
| | | DNC | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | HEX |
| Command | | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 86 |
| 1 | parameter | - | B31 | B30 | B29 | B28 | B27 | B26 | B25 | B24 | xx |
| 2 | parameter | - | B23 | B22 | B21 | B20 | B19 | B18 | B17 | B16 | xx |
| 3 | parameter | - | B15 | B14 | B13 | B12 | B11 | B10 | B9 | B8 | xx |
| 4 | parameter | - | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | xx |
| 5 | parameter | - | E3 | E2 | E1 | E0 | F1 | P2 | P1 | P0 | xx |
| 6 | parameter | - | B23 | B22 | B21 | B20 | B19 | B18 | B17 | B16 | xx |
| : | | - | : | : | : | : | : | : | : | : | : |
| (n+1) Parameter | | - | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | xx |
| Description | | <p>This command returns touch co-ordinates what is the oldest co-ordinates information what has been stored on the stock. A returning value can be "No Event" if the stock is empty. The default assignment is list as below. The assignment of event stack also can be modified if necessary (base on the requirement of customer).</p> | | | | | | | | | |
| Register Availability | | Status | | | | | Availability | | | | |
| | | TS Sleep Out | | | | | Yes | | | | |
| | | TS Sleep In | | | | | Yes | | | | |
| Default | | Status | | | | | Default Value | | | | |
| | | Power Up Sequence | | | | | All Values 0000 0000h | | | | |
| | | TS S/W Reset | | | | | All Values 0000 0000h | | | | |

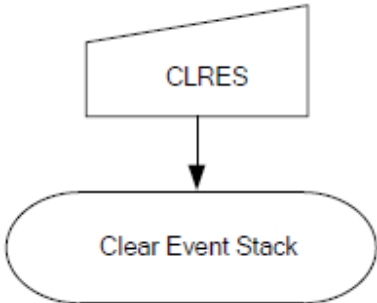


10.3.8 Read Latest Event (87h)

| 87H | | RLE (Read Latest Event) | | | | | | | | | |
|-----------------------|-----------|---|-----|-----|-----|-----|---------------|-----|-----|-----|-----|
| | | DNC | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | HEX |
| Command | | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 87 |
| 1 | parameter | - | B31 | B30 | B29 | B28 | B27 | B26 | B25 | B24 | xx |
| 2 | parameter | - | B23 | B22 | B21 | B20 | B19 | B18 | B17 | B16 | xx |
| 3 | parameter | - | B15 | B14 | B13 | B12 | B11 | B10 | B9 | B8 | xx |
| 4 | parameter | - | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 | xx |
| Description | | <p>This command returns one touch event what is the latest co-ordinates information what has been stored on the stock.</p> <p>The event stack is empty after this command.</p> <p>A returning value can be “No Event” if the stock is empty.</p> <p>The default assignment is list as below. The assignment of event stack also can be modified if necessary (base on the requirement of customer).</p> | | | | | | | | | |
| Register Availability | | Status | | | | | Availability | | | | |
| | | TS Sleep Out | | | | | Yes | | | | |
| | | TS Sleep In | | | | | Yes | | | | |
| Default | | Status | | | | | Default Value | | | | |
| | | Power Up Sequence | | | | | 0000 0000h | | | | |
| | | TS S/W Reset | | | | | 0000 0000h | | | | |
| | | H/W Reset | | | | | 0000 0000h | | | | |



10.3.9 Clear Event Stack (88h)

| 88H | CLRES (Clear Event Stack) | | | | | | | | | |
|-----------------------|---|----|----|----|----|---------------|----|----|----|-----|
| | DNC | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | HEX |
| Command | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 88 |
| parameter | No parameter | | | | | | | | | |
| Description | This command clears event stack when the only return event can be "No Event". | | | | | | | | | |
| Restriction | | | | | | | | | | |
| Register Availability | Status | | | | | Availability | | | | |
| | TS Sleep Out | | | | | Yes | | | | |
| | TS Sleep In | | | | | Yes | | | | |
| Default | Status | | | | | Default Value | | | | |
| | Power Up Sequence | | | | | Empty Stack | | | | |
| | TS S/W Reset | | | | | Empty Stack | | | | |
| | H/W Reset | | | | | Empty Stack | | | | |
| Flow Chart | <div style="border: 1px dashed black; padding: 10px;"> <p style="text-align: center;">Legend</p> <div style="display: flex; flex-direction: column; align-items: center;"> <div style="border: 1px solid black; width: 100px; height: 30px; margin-bottom: 5px;"></div> <div style="border: 1px solid black; width: 100px; height: 30px; margin-bottom: 5px; transform: rotate(-15deg);"></div> <div style="border: 1px solid black; width: 100px; height: 30px; margin-bottom: 5px; border-radius: 15px;"></div> <div style="border: 1px solid black; width: 100px; height: 30px; margin-bottom: 5px; border-radius: 15px;"></div> <div style="border: 1px solid black; width: 100px; height: 30px; margin-bottom: 5px; border-radius: 15px;"></div> <div style="border: 1px solid black; width: 100px; height: 30px; margin-bottom: 5px; border-radius: 15px;"></div> </div> <div style="margin-top: 20px; text-align: center;">  <pre> graph TD A[CLRES] --> B([Clear Event Stack]) </pre> </div> </div> | | | | | | | | | |

11. OPTICAL CHARACTERISTICS

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit | Remark |
|--------------------|--------|----------------------------|------|------|------|-------------------|----------|
| Response time | Tr+Tf | $\theta=0^\circ$ | - | 25 | - | ms | Note 4 |
| Contrast ratio | CR | At optimized viewing angle | 100 | 400 | | | Note 5 |
| Viewing angle | Top | CR \geq 10 | 40 | 50 | - | Deg. | Note 6 |
| | Bottom | | 60 | 70 | - | | |
| | Left | | 60 | 70 | - | | |
| | Right | | 60 | 70 | - | | |
| Luminance of white | | $\theta=0^\circ$ | 270 | 340 | -- | cd/m ² | Note 7,8 |
| Uniformity | | | 70 | -- | | % | Note 8,9 |
| White chromaticity | X | $\theta=0^\circ$ | 0.27 | 0.32 | 0.37 | | Note 7 |
| | y | | 0.28 | 0.33 | 0.38 | | |

Note 1: Ambient temperature =25°C. LED current $I_L=20$ mA.

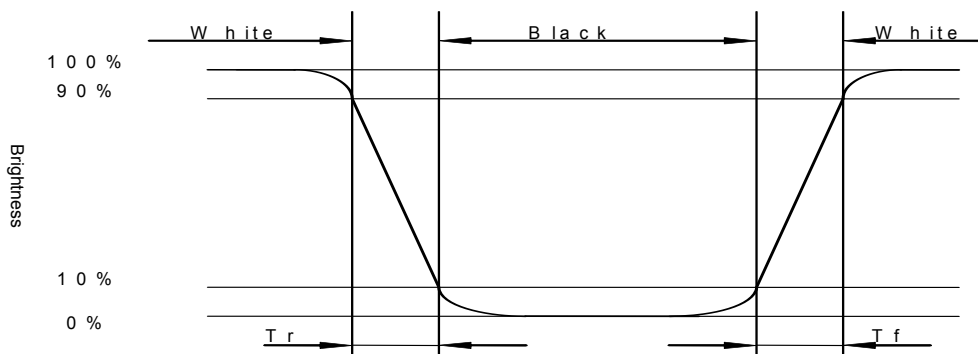
Note 2: To be measured in the dark room.

Note 3: To be measured on the center area of panel with a viewing cone of 1° by Topcon luminance meter BM-7A, after 2 minutes operation.

Note 4: Definition of response time:

The output signals of photo-detector are measured when the input signals are changed from "white" to "black"(rising time) and from "black" to "white"(falling time), respectively.

The response time is defined as the time interval between the 10% and 90% of amplitudes. Refer to figure as shown below.

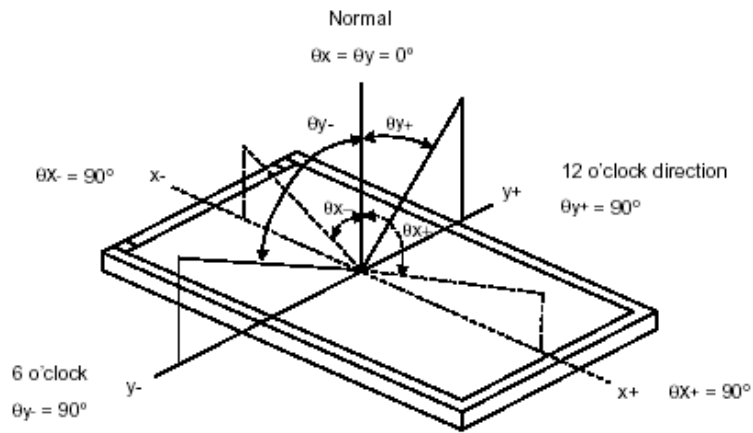


Note5: Definition of contrast ratio:

Contrast ratio is calculated with the following formula.

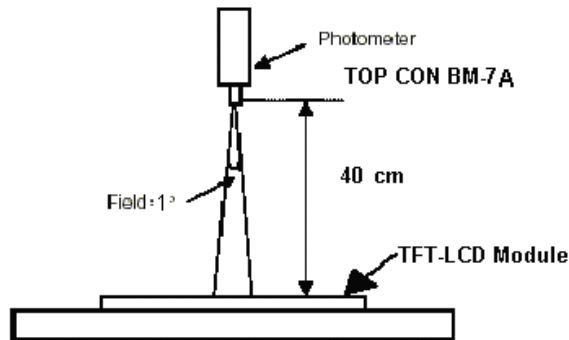
$$\text{Contrast ratio (CR)} = \frac{\text{Photo-detector output when LCD is at "White" state}}{\text{Photo-detector output when LCD is at "Black" state}}$$

Note 6: Definition of viewing angle:
Refer to figure as below.

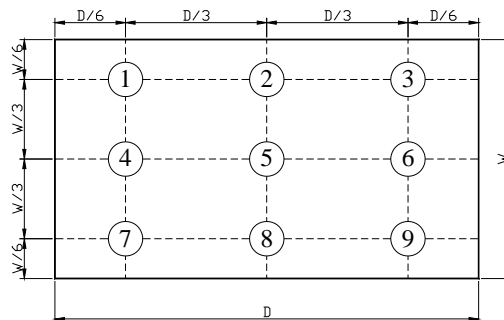


Note 7: Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

Note 8: The method of optical measurement



Note 9: Definition of Brightness Uniformity (B-uni):



$$B\text{-uni} = \frac{\text{Minimum luminance of 9 points}}{\text{Maximum luminance of 9 points}} \quad (\text{Note 9}).$$

12. QUALITY ASSURANCE

12.1 Test Condition

12.1.1 Temperature and Humidity(Ambient Temperature)

Temperature : $25 \pm 5^{\circ}\text{C}$

Humidity : $65 \pm 5\%$

12.1.2 Operation

Unless specified otherwise, test will be conducted under function state.

12.1.3 Container

Unless specified otherwise, vibration test will be conducted to the product itself without putting it in a container.

12.1.4 Test Frequency

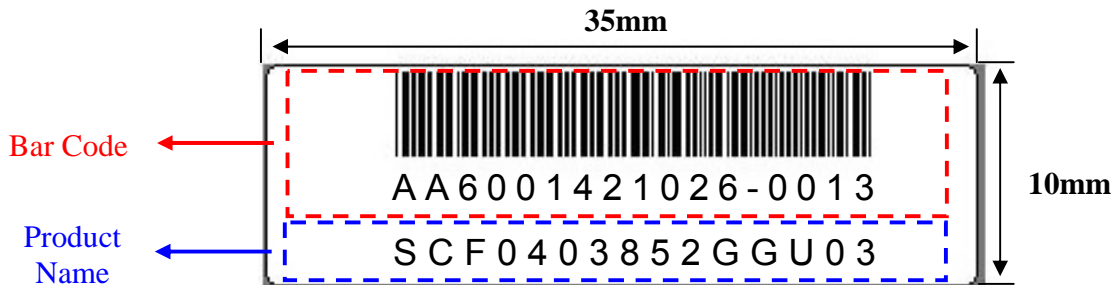
In case of related to deterioration such as shock test. It will be conducted only once.

12.1.5 Test Method

| No. | Reliability Test Item & Level | Test Level |
|-----|---|--|
| 1 | High Temperature Storage Test | T=80°C,240hrs |
| 2 | Low Temperature Storage Test | T=-30°C,240hrs |
| 3 | High Temperature Operation Test | T=70°C,240hrs |
| 4 | Low Temperature Operation Test | T=-20°C,240hrs |
| 5 | High Temperature and High Humidity Operation Test | T=60°C,90% RH,240hrs |
| 6 | Thermal Cycling Test (No operation) | -30°C → +25°C → +80°C,200 Cycles 30 min 5min 30 min |
| 7 | Vibration Test (No operation) | Frequency:0 ~ 55 Hz Amplitude:1.5 mm Sweep Time:11min Test Period:6 Cycles for each Direction of X,Y,Z |
| 8 | Electrostatic Discharge Test (No operation) | 150pF,330Ω Air:± 15KV;Contact: ± 8KV 10 times/point;4 points/panel face |

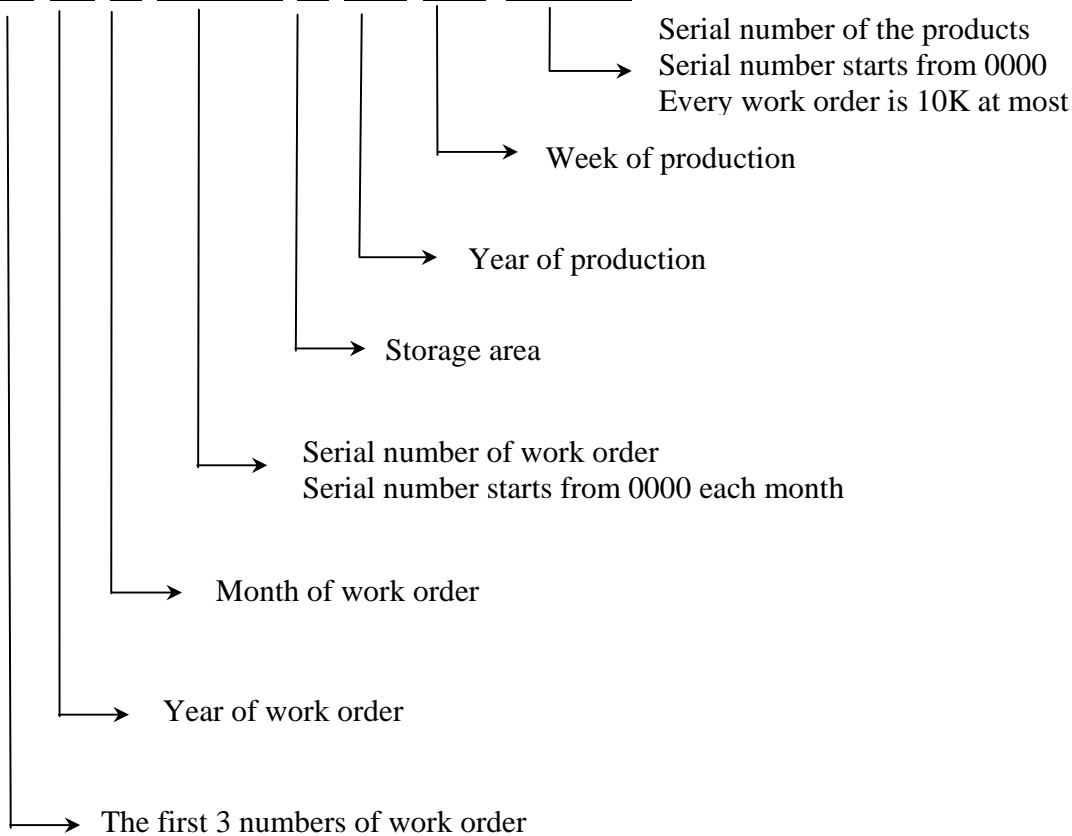
13. LCM PRODUCT LABEL DEFINE

Product Label style:

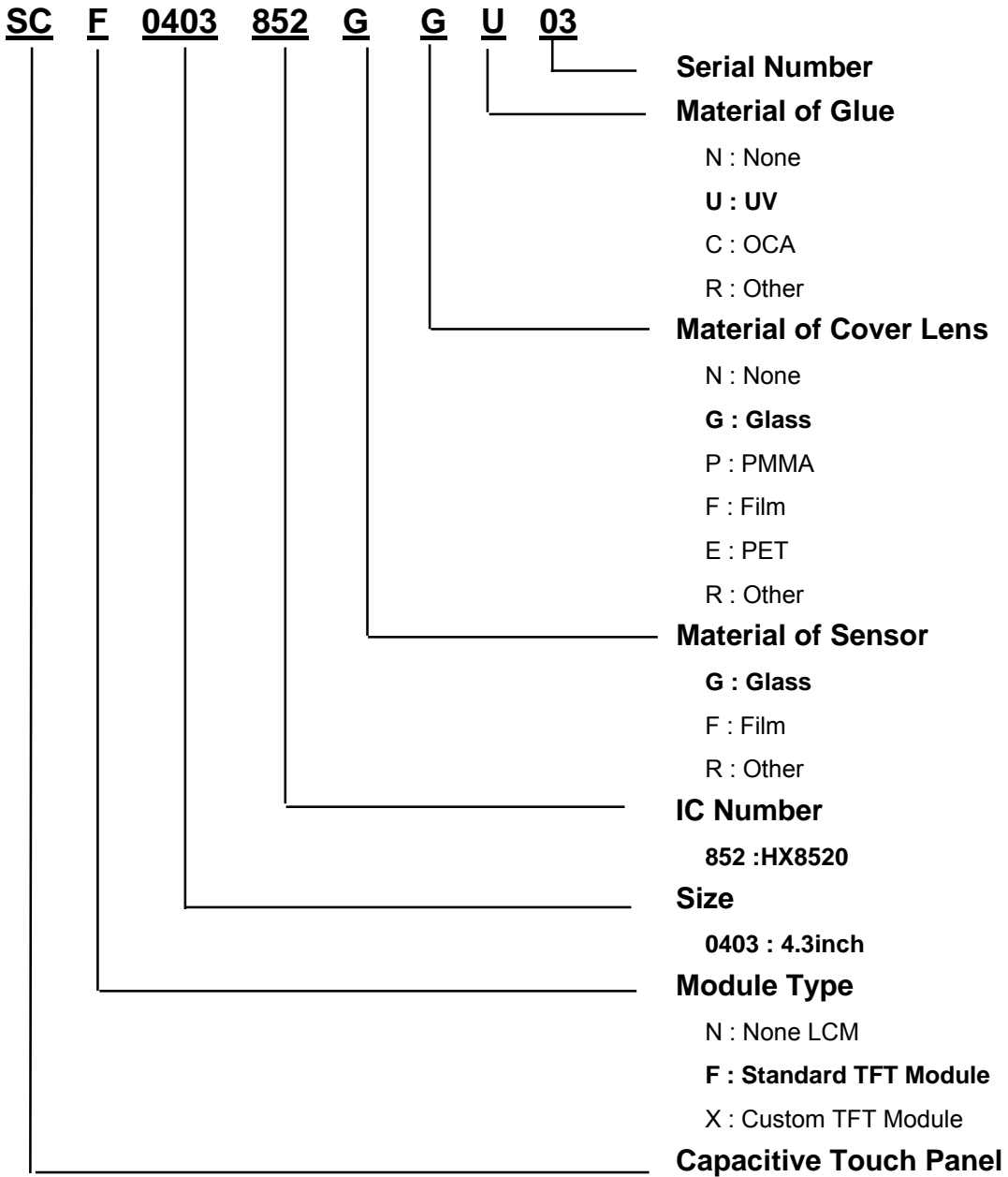


Bar Code Define:

A A 6 0014 2 10 26-0013



Product Name Define:



14. PRECAUTIONS IN USE LCM

1. LIQUID CRYSTAL DISPLAY (LCD)

LCD is made up of glass, organic sealant, organic fluid, and polymer based polarizers. The following precautions should be taken when handling,

- (1). Keep the temperature within range of use and storage. Excessive temperature and humidity could cause polarization degradation, polarizer peel off or bubble.
- (2). Do not contact the exposed polarizers with anything harder than an HB pencil lead. To clean dust off the display surface, wipe gently with cotton, chamois or other soft material soaked in petroleum benzin.
- (3). Wipe off saliva or water drops immediately. Contact with water over a long period of time may cause polarizer deformation or color fading, while an active LCD with water condensation on its surface will cause corrosion of ITO electrodes.
- (4). Glass can be easily chipped or cracked from rough handling, especially at corners and edges.
- (5). Do not drive LCD with DC voltage.

2. Liquid Crystal Display Modules

2.1 Mechanical Considerations

LCM are assembled and adjusted with a high degree of precision. Avoid excessive shocks and do not make any alterations or modifications. The following should be noted.

- (1). Do not tamper in any way with the tabs on the metal frame.
- (2). Do not modify the PCB by drilling extra holes, changing its outline, moving its components or modifying its pattern.
- (3). Do not touch the elastomer connector, especially insert an backlight panel (for example, EL).
- (4). When mounting a LCM make sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.
- (5). Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels.

2.2. Static Electricity

LCM contains CMOS LSI's and the same precaution for such devices should apply, namely

- (1). The operator should be grounded whenever he/she comes into contact with the module. Never touch any of the conductive parts such as the LSI pads, the copper leads on the PCB and the interface terminals with any parts of the human body.
- (2). The modules should be kept in antistatic bags or other containers resistant to static for storage.
- (3). Only properly grounded soldering irons should be used.
- (4). If an electric screwdriver is used, it should be well grounded and shielded from commutator sparks.

- (5) The normal static prevention measures should be observed for work clothes and working benches; for the latter conductive (rubber) mat is recommended.
- (6). Since dry air is inductive to statics, a relative humidity of 50-60% is recommended.

2.3 Soldering

- (1). Solder only to the I/O terminals.
- (2). Use only soldering irons with proper grounding and no leakage.
- (3). Soldering temperature : $280^{\circ}\text{C} \pm 10^{\circ}\text{C}$
- (4). Soldering time: 3 to 4 sec.
- (5). Use eutectic solder with resin flux fill.
- (6). If flux is used, the LCD surface should be covered to avoid flux spatters. Flux residue should be removed afterwards.

2.4 Operation

- (1). The viewing angle can be adjusted by varying the LCD driving voltage V_0 .
- (2). Driving voltage should be kept within specified range; excess voltage shortens display life.
- (3). Response time increases with decrease in temperature.
- (4). Display may turn black or dark blue at temperatures above its operational range; this is (however not pressing on the viewing area) may cause the segments to appear "fractured".
- (5). Mechanical disturbance during operation (such as pressing on the viewing area) may cause the segments to appear "fractured".

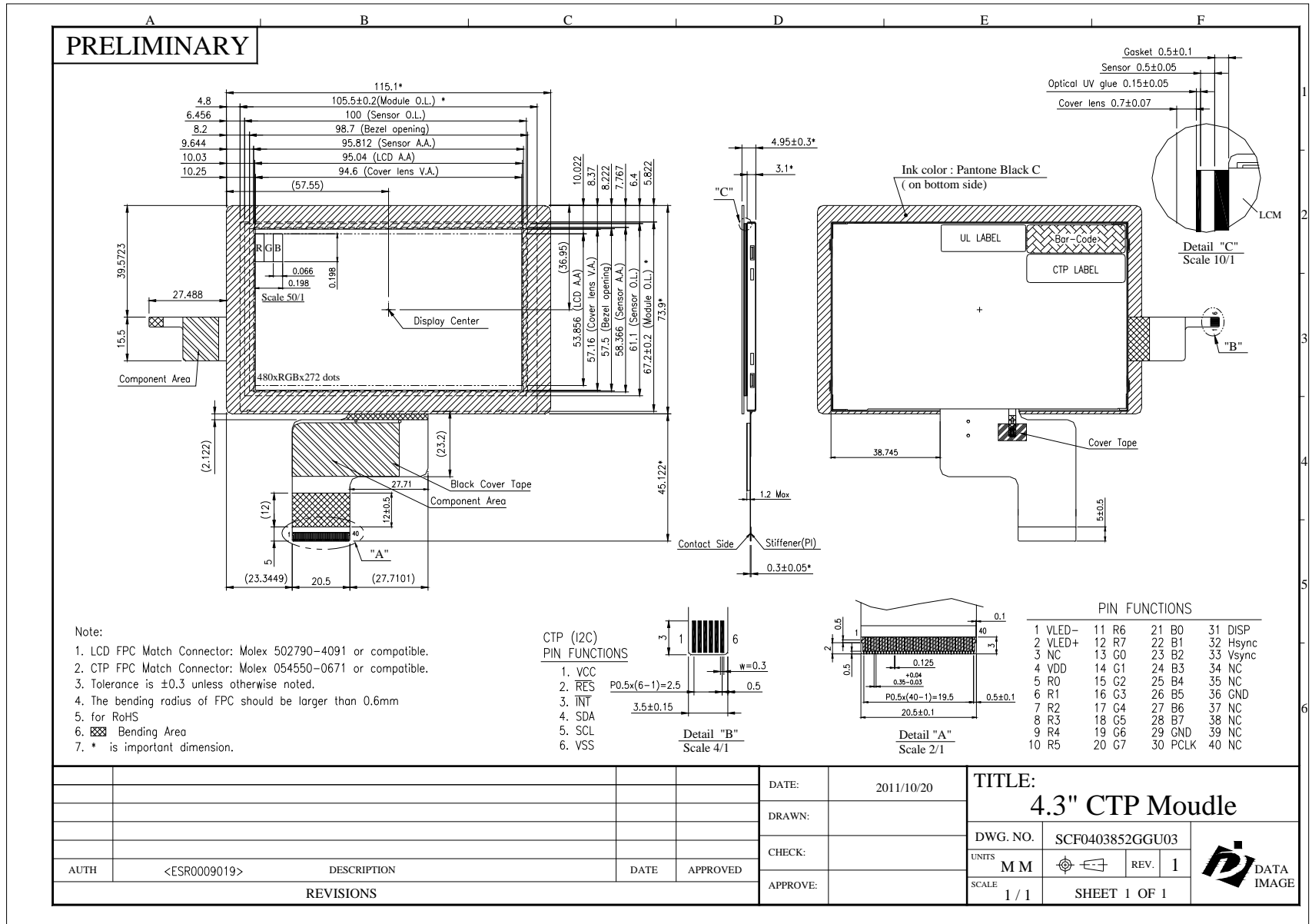
2.5 Storage

If any fluid leaks out of a damaged glass cell, wash off any human part that comes into contact with soap and water. Never swallow the fluid. The toxicity is extremely low but caution should be exercised at all the time.

2.6 Limited Warranty

Unless otherwise agreed between DATA IMAGE and customer, DATA IMAGE will replace or repair any of its LCD and LCM which is found to be defective electrically and visually when inspected in accordance with DATA IMAGE acceptance standards, for a period on one year from date of shipment. Confirmation of such date shall be based on freight documents. The warranty liability of DATA IMAGE is limited to repair and/or replacement on the terms set forth above. DATA IMAGE will not responsible for any subsequent or consequential events.

Confidential Document
15. OUTLINE DRAWING



16. PACKAGE INFORMATION (TBD)